

REMARKS ON THE NEW WORLD PSEUDOSCORPION GENERA *PARAWITHIUS* AND *VICTORWITHIUS*, WITH A NEW GENUS BEARING A REMARKABLE STERNAL MODIFICATION (PSEUDOSCORPIONES, WITHIIDAE)

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ABSTRACT. The withiid genus *Parawithius* Chamberlin is rediagnosed, based upon a detailed examination of the type species, *P. nobilis* (With) from Colombia, which is redescribed and illustrated. The subgenus *Parawithius* (*Victorwithius*) Feio is returned to full generic level. *Cystowithius*, a new genus of Withiidae, is described from high elevation localities in central and South America for four species: *Cystowithius smithersi* new species (type species) from Ecuador, *C. ecuadoricus* (Beier) new combination, from Ecuador and Peru, *C. colombicus* new species from Colombia, and *C. chamberlini* new species from Mexico and Guatemala. Males of *Cystowithius* are highly unusual due to the presence of sternal invaginations, a feature that has not been previously observed in pseudoscorpions. Populations of *Cystowithius smithersi* occur within the leaf sheaths of the giant rosette plant *Espeletia pycnophylla* var. *angelensis* (Compositae).

Keywords: Taxonomy, new species, new genus, Colombia, Ecuador, Peru, Mexico, Guatemala, *Espeletia*, high elevation, *Cystowithius*

The pseudoscorpion family Withiidae is distributed in most parts of the world with 34 genera and 153 species currently recognized (Harvey 1991). The family is divided into two subfamilies, Withiinae Chamberlin and Paragoniochernetinae Beier, but the relationships both within and between these groups are poorly known. The South American withiid fauna consists of seven endemic genera (Harvey 1991) which are currently placed in three tribes: *Cacodemonius* Chamberlin in the Cacodemoniini, *Protowithius* Beier 1955 in the Protowithiini, and *Balanowithius* Beier 1959, *Dolichowithius* Chamberlin 1931, *Neowithius* Beier 1932, *Parawithius* Chamberlin 1931 and *Tropidowithius* Beier 1955 in the Withiini. In addition, the cosmopolitan synanthropic species *Withius piger* (Simon 1879) has also been recorded from Chile. The composition and relationships of these genera are only poorly known and considerable problems exist in the systematics of the withiines, even at the generic level.

During a recent survey of the fauna associated with the leaf sheaths of the giant rosette plant *Espeletia pycnophylla* var. *angelensis* on the western slopes of Volcán Chiles, an extinct

volcano 15 km north of Tulcán, in northern Ecuador, Smithers et al. (2001) found many pseudoscorpion specimens inhabiting the spaces formed between the sheaths. Detailed examination of the specimens showed that they represented a single species of Withiidae with a peculiar modification to the male sternites in which the anterior-lateral edge of sternites V–VIII were invaginated to form pockets within the inter-segmental membrane. Subsequent examination of museum collections revealed that while such a structure is rare among the Withiidae, further American specimens were found with such invaginations. The feature was found to be absent from other withiid genera and I here propose a new genus, here named *Cystowithius*, for these species. In addition, the type species of *Parawithius*, *P. nobilis* (With 1908), is redescribed based upon the male holotype and a second male specimen collected from a nearby locality, and the status of the species currently assigned to the subgenus *Parawithius* (*Victorwithius*) Feio 1944 is reassessed.

METHODS

The specimens that formed the basis for this study are lodged in the American Museum of

Natural History, New York (AMNH), the Natural History Museum, London (BMNH), the California Academy of Sciences, San Francisco (CAS), Museum Victoria, Melbourne (NMV), Naturhistorisches Museum, Wien (NHMW), Museum National d'Histoire Naturelle, Paris (MNHN), Pontificia Universidad Católica del Ecuador, Quito (PUCE), Bohart Museum of Entomology, University of California, Davis (UCD), Western Australian Museum, Perth (WAM) and Museum für Naturkunde der Humboldt-Universität, Berlin (ZMB). Terminology largely follows Chamberlin (1931a) and Harvey (1992). In particular, it should be noted that the terminology for the trichobothria used by Harvey (1992) differs slightly from that used by other workers. The ratio TS is the distance from the base of tarsus IV to the tactile seta, divided by the length of the entire tarsus. The tergal and sternal chaetotaxies (including those of the glandular setae) refer to the entire segment, and not merely half-segments as is often presented in descriptions of some cheliferoid pseudoscorpion taxa. All measurements are in mm and were made with an ocular micrometer on a compound or a dissecting microscope. Specimens were examined by either clearing in 50% lactic acid or by permanently mounting in Euparal on microscope slides. The scanning electron micrographs were obtained in a Philips XL30 scanning electron microscope after the specimens were prepared by dehydration in 1,1,1,3,3,3-Hexamethyldisilazane (HMDS), air-drying and mounting on SEM stubs with carbon tape.

SYSTEMATICS

FAMILY WITHIIDAE CHAMBERLIN

1931

SUBFAMILY WITHIINAE CHAMBERLIN

1931

Genus *Parawithius* Chamberlin 1931

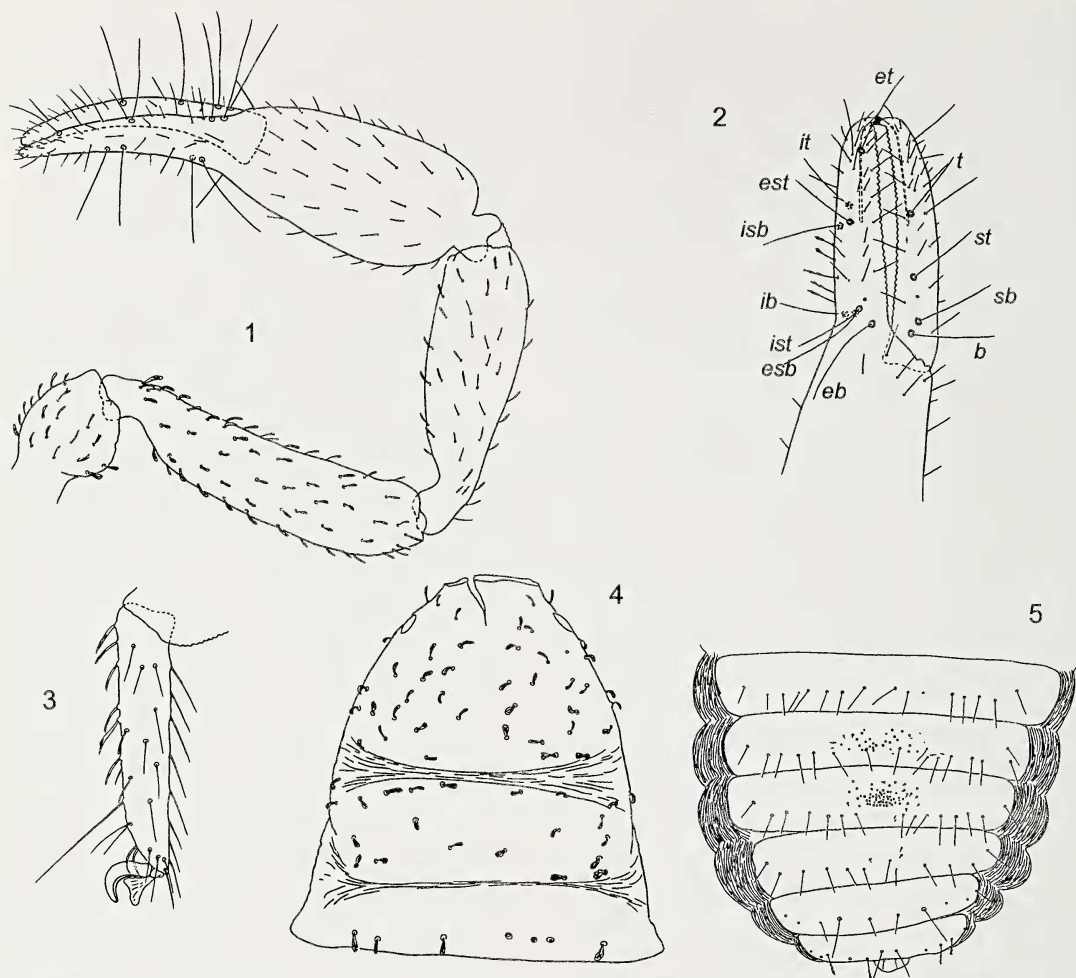
Parawithius Chamberlin 1931b: 292; Beier 1932a: 212; Beier 1959: 216; Harvey 1991: 650.

Type species.—*Chelifer nobilis* With 1908, by original designation.

Diagnosis.—The genus *Parawithius* is here defined by the following combination of characters: tactile seta of tarsus IV sub-distal (rather than sub-medial); carapace broadest posteriorly; trichobothria *est*, *isb* and *it* nearly adjacent to each other; male tergites without

lateral tergal crests; patches of glandular setae only present on sternites VII-IX of males; males without sternal invaginations; and tergites without discrete the lateral fields characteristic of *Cacodemonius*.

Remarks.—The genus *Parawithius* comprises two distinct groups which were treated as subgenera by Beier (1959), *Parawithius* (*Parawithius*) and *Parawithius* (*Victorwithius*) Feio 1944, which differ in the position of trichobothria *isb* and *it*, which are nearly adjacent to each other in the nominate subgenus but which are somewhat separated in all species of *Victorwithius*. The subgenus *Parawithius* (*Parawithius*) currently contains the type species *P. (P.) nobilis* (With 1908) from Colombia, *P. (P.) nobilis nobilis*, and Ecuador and Peru (*P. (P.) nobilis ecuadoricus* Beier 1959), and *P. (P.) iunctus* Beier 1932b and *P. (P.) pseudorufus* Beier 1932b from Paraguay. *Parawithius* (*Victorwithius*) consists of 12 species, *P. (V.) coniger* Mahnert 1979, *P. (V.) fiebrigi* Beier 1932b, *P. (V.) gracilimanus* Mahnert 1979, *P. (V.) incognitus* Beier 1959, *P. (V.) mimulus* (Beier 1954), *P. (V.) monoplacophorus* Feio 1944, *P. (V.) proximus* Ellingsen 1905, *P. (V.) rufolus* Beier 1959, *P. (V.) rufus* Balzan 1887, *P. (V.) schlingeri* Beier 1959, *P. (V.) similis* Beier 1959 and *P. (V.) venezuelanus* Beier 1932b. The removal of all of those species previously placed in *Parawithius* (*Victorwithius*) to the full genus *Victorwithius* (see below) and the transfer of *P. nobilis ecuadoricus* to the new genus *Cystowithius* (see below) leaves only *P. nobilis* from Colombia, and *P. iunctus* and *P. pseudorufus* from Paraguay remaining in the genus *Parawithius*. I have examined material of all three of these species, including the type specimens of each and have confirmed that *P. nobilis* and *P. pseudorufus* are not conspecific with any of the species of *Cystowithius* described elsewhere in this paper, and that they lack the diagnostic features of *Cystowithius*. Beier (1932b) stated that the holotype of *P. iunctus* (ZMB 29667) was a male. In fact, the specimen is a female, as indicated on the determination label associated with the specimen. It is currently not possible to easily separate isolated female specimens of *Parawithius* and *Cystowithius*, so it is not certain to which genus the female holotype of *P. iunctus* belongs. It is here retained in *Parawithius* until the Paraguayan withiid fauna becomes better known.



Figures 1–5.—*Parawithius nobilis* (With), holotype ♂ unless stated otherwise: 1. Right pedipalp, dorsal; 2. Right chela, lateral; 3. Right tarsus IV, ♂ from 12 miles E. of Bogotá, Colombia; 4. Carapace, dorsal; 5. Posterior sternites, ventral. Trichobothrial abbreviations follow Chamberlin (1931) and Harvey (1992).

Parawithius nobilis (With 1908)

Figs. 1–6

Chelifer nobilis With 1908: 234–236, figs 4a–b.

Parawithius nobilis (With): Chamberlin 1931b: 292; Beier 1932a: 213; Roewer 1937: 309; Beier 1959: 216–217, fig. 25; Muchmore 1993: 99; Judson 1997: 30.

Parawithius (*Parawithius*) *nobilis* (With): Harvey 1991: 650.

Material examined.—Holotype male, Bogotá, Cundinamarca, COLOMBIA [4°36'N, 74°05'W], Keyserling collection (BMNH).

Other material: Cundinamarca: COLOMBIA 1 ♂, 12 miles E. of Bogotá [ca. 4°36'N, 73°52'W], 3 March 1955, E.I. Schlinger, E.S. Ross (CAS).

Diagnosis.—*Parawithius nobilis* differs from *P. iunctus* and *P. pseudorufus* by the presence of pale spots on the carapaceal metazone, by the slightly stouter pedipalpal segments (e.g. patella 3.24–3.30 times longer than broad, compared with 3.4–3.6 times longer than broad), and the morphology of the setae on the interior face of the pedipalpal segments, which are only slightly clavate in *P. nobilis* and clearly clavate in *P. iunctus* and *P. pseudorufus*.

Description.—**Adult males:** Color generally light red-brown; carapaceal metazone with large paired pale areas; tergites I–III with pale areas on each tergal half, tergites IV–IX with pale areas on each tergal half situated medi-

ally thus forming a distinct medial band. Pedipalp (Fig. 1): all segments granulate, except for chelal fingers, which are smooth; dorsal setae generally strongly foliate; trochanter 1.69–1.75, femur 4.22–4.25, patella 3.24–3.30, chela (with pedicel) 3.60–3.71, chela (without pedicel) 3.39–3.47, hand 1.73–1.78 times longer than broad, movable finger 0.99–1.04 times longer than hand. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Fig. 2): *eb* and *esb* situated basally; *est*, *it* and *isb* grouped together sub-medially; *ist* and *ib* situated basally; *b* and *sb* situated near one another; *st* slightly closer to *sb* than to *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus near *est* in fixed finger and near *t* in movable finger. Chelal teeth strongly triangular, slightly retrorse; fixed finger with 35 teeth; movable finger with 34 teeth; accessory teeth absent. Chelicera with 5 setae on hand, *bs* and *sbs* dentate; movable finger with 1 submedial seta; galea short with 4 small terminal rami; flagellum of 4 blades; serrula exterior with 14–17 blades; lamina exterior present. Carapace (Fig. 4) 1.27–1.69 times longer than broad; lateral margins evenly convex, but posteriorly widened; with 2 non-corneate eyes, those of holotype apparently smaller than those of other male; with ca. 52 setae, including 4 near anterior margin and 7–8 near posterior margin; with 2 deep furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Tergites with distinct medial suture, sternites barely divided. Chaetotaxy of tergites I–XII: 9–10: 9–10: 11: 12–15: 14–17: 15–16: 15–17: 17–18: 17: 14: 6: 2; mostly uniseriate but some tergites with a few setae placed anteriorly; all setae foliate. Chaetotaxy of sternites I–XII: 12: (2)10(2): (2)11(2): 14–16: 16: 16: 15–16: 11–12: 9–10: 9–11: 2; sternites VII–IX with patches of glandular setae, arranged 26–41: ca. 63–77: 3–5 respectively; setae uniseriate and acuminate, except for smaller setae on sternite XI which are denticulate; glandular setae small and conical in shape; ♂ without paired invaginations on anterior margins of sternites. Coxal chaetotaxy 12: 10: 10: 18; pedipalpal coxa with 2 apical setae and very small sub-oral seta. Internal genitalia not observed. Legs: junction between femora and patellae I and II only slightly oblique; femur + patella of leg IV 3.00

times longer than broad; tarsal tactile seta of leg IV situated sub-distally, ca. 0.74 of tarsus length; subterminal tarsal setae arcuate and acute; arolium slightly shorter than claws.

Dimensions (mm), males: Body length 2.32–2.64. Pedipalps: trochanter 0.422–0.435/0.248–0.250, femur 0.883–0.896/0.209–0.211, patella 0.762–0.782/0.235–0.237, chela (with pedicel) 1.196–1.229/0.331–0.332, chela (without pedicel) 1.125–1.150, hand length 0.567–0.591, movable finger length 0.588–0.592. Chelicera 0.237/0.122, movable finger length 0.180. Carapace 0.832–0.848/0.501–0.656 (width at medial area); eye diameter 0.045–0.105. Leg I: femur 0.179/0.157, patella 0.378/0.160, tibia 0.352/0.105, tarsus 0.340/0.069. Leg IV: femur + patella 0.662/0.224, tibia 0.511/0.128, tarsus 0.396/0.080, TS 0.294.

Remarks.—*Parawithius nobilis* has been infrequently recorded in the literature, and the only known specimens are the male holotype from Bogotá (With 1908), a male specimen from 'New Granada' (now Colombia) (With 1908), a male from near Bogotá (Beier 1959), and six adults from Lago Zurucuchu, Ecuador and a female from Huamachuco, Peru (Beier 1959). The specimens from Lago Zurucuchu and Huamachuco were regarded as a separate subspecies by Beier (1959) who named them *Parawithius nobilis ecuadoricus* Beier, but which are here treated as a distinct species of *Cystowithius* (see below). The holotype of *Chelifier nobilis* lodged in the BMNH is in good condition, but a fine covering of minute crystals has obscured the specimen in some places, in particular the coxal region, thus precluding the determination of the setal formula of the coxae. The description presented above is based upon the male holotype and the male from near Bogotá lodged in CAS. Both specimens are very similar in all morphological features including the size and shape of the pedipalpal segments and in the number of glandular setae on the male sternites. I have not examined the specimen lodged in the BMNH from New Granada that was referred to by With (1908).

Genus *Victorwithius* Feio 1944

Victorwithius Feio 1944: 1–3.

Cacodemoniellus Beier 1954: 326–327 (synonymized by Beier 1959: 216).

Parawithius (*Victorwithius*) Feio: Beier 1959: 216; Harvey 1991: 651.

Type species.—Of *Victorwithius*: *Victorwithius monoplacophorus* Feio 1944, by original designation; of *Cacodemoniellus*: *Cacodemoniellus mimulus* Beier 1954, by original designation.

Diagnosis.—Species of *Victorwithius* differ from other South American withiids by the following combination of characters: tactile seta of tarsus IV situated sub-distally; trichobothrium *it* situated mid-way between the tip of the finger and *isb*; and tergites without discrete the lateral fields characteristic of *Cacodemonius*.

Remarks.—The subgenus *Victorwithius* is a distinct and easily recognizable taxon that is here returned to full generic rank. It differs from *Parawithius* in the position of trichobothrium *it* which is situated mid-way between the tip of the finger and *isb* in *Victorwithius* but is situated close to *isb* in *Parawithius*. The distinction between *Victorwithius* and some other South American genera such as *Balanowithius* is difficult to confirm, and further research on the relationships of these genera is necessary to establish their interrelationships and hence the limits of the genera. The following species are placed in the genus *Victorwithius*:

Victorwithius coniger (Mahnert 1979) NEW COMBINATION

Victorwithius fiebrigi (Beier 1932b) NEW COMBINATION

Victorwithius gracilimanus (Mahnert 1979) NEW COMBINATION

Victorwithius incognitus (Beier 1959) NEW COMBINATION

Victorwithius mimulus (Beier 1954) NEW COMBINATION

Victorwithius monoplacophorus Feio 1944

Victorwithius proximus (Ellingsen 1905) NEW COMBINATION

Victorwithius rufescens (Beier 1959) NEW COMBINATION

Victorwithius rufus (Balzan 1887) NEW COMBINATION

Victorwithius schlingeri (Beier 1959) NEW COMBINATION

Victorwithius similis (Beier 1959) NEW COMBINATION

Victorwithius venezuelanus (Beier 1932b) NEW COMBINATION

Genus *Cystowithius* new genus

Type species.—*Cystowithius smithersi* new species.

Etymology.—The generic epithet refers to the cyst-like invaginations that diagnose the genus (*kystis*, Greek for bladder, sac or cell), combined with the generic stem *Withius*. The name was first used for this taxon by the late J.C. Chamberlin, who labelled the Mexican specimens described below as "*Cystowithius* gen. nov." The gender is masculine.

Diagnosis.—Males of *Cystowithius* are unlike those of any other pseudoscorpion in the possession of paired sac-like invaginations on the anterior margins of sternites V–VIII (*C. smithersi* and *C. ecuadoricus*) or VI–VII (*C. colombicus*) or VI–VIII (*C. chamberlini*) (Figs. 18, 19).

Description.—Most dorsal setae strongly denticulate; setae on sternites acicular. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria; trichobothria *est*, *it* and *isb* grouped together sub-medially. Venom apparatus present in both chelal fingers, venom duct terminating in nodus ramosus near *est* in fixed finger and near *t* in movable finger. Chelal teeth all closely spaced; accessory teeth absent. Chelicera with 5 setae on hand, *bs* and *sbs* denticulate, others acuminate; movable finger with 1 subdistal seta; flagellum of 4 blades, the most distal blade with several serrations on leading edge, other blades smooth; lamina exterior present. Carapace with 2 non-corneate eyes; with 2 distinct furrows, posterior furrow closer to posterior margin of carapace than to anterior furrow. Tergites I–X with medial suture, sternites IV–X with faint medial suture. Males with paired sac-like invaginations on anterior margins of sternites V–VIII or VI–VII or VI–VIII; males with patches of glandular setae on sternites VII–X, females with 2 glandular setae per segment on segments VII–IX (*C. smithersi*) or VIII–IX (*C. ecuadoricus*, *C. colombicus* and *C. chamberlini*); glandular setae small and conical in shape. Male genitalia with lateral apodeme long and triangular. Female genitalia with single oval median cribiform plate and 2 smaller lateral cribiform plates; with poorly defined membranous spermathecal sac irregularly covered with pores; and with 2 lateral hooked apodemes. Pleural membrane longitudinally striate. Posterior

maxillary lyrifissure present and sub-distally situated. Spiracular helix present. Legs: junction between femora and patellae I and II only slightly oblique; subterminal tarsal setae arcuate and acute; arolium slightly shorter than claws; claws slender and simple.

Remarks.—The presence of sternal invaginations in *Cystowithius* is unique within the Pseudoscorpiones. This feature has been observed in all males here assigned to the genus, but was found to be absent in other withiids (Table 1). The structure appears to be autapomorphic for the four species described below. While the feature is easily seen in slide-mounted specimens (either as permanent mounts or as temporary mounts in glycerol or lactic acid) using a compound microscope, it is still visible in material examined in ethanol using a dissecting microscope, as the antero-lateral margins of the sternite are slightly curved and somewhat darker than the remaining sternal cuticle. It was not observed using a scanning electron microscope as the slight contraction of the specimen during the dehydration process hides from view the invagination (Fig. 22).

The conformation of the male genitalia of *Cystowithius* spp. resembles that of some other withiids as they possess an elongate, triangular lateral apodeme that bears an extended ejaculatory canal (Fig. 21). This feature also occurs in several species of *Withius*, including *W. hispanus* (L. Koch 1873), *W. faunus* (Simon 1879), *W. neglectus* (Simon 1878) (Heurtault 1971), *Metawithius yurii* (Redikorzev 1938) (Harvey 1988), *M. murrayi* (Pocock 1900) (pers. obs.), *M. philippinus* Beier 1937 (pers. obs.), *M. spiniventer* Redikorzev 1938 (pers. obs.), *Pycnowithius cavernicola* Mah-

nert 1988 (Mahnert 1988), *Rexwithius girardi* Heurtault 1993 (Heurtault 1993), *Trichotowithius abyssinicus* Beier 1944 (Dashdamirov 1992) and possibly in *Victorwithius monoplacophorus* Feio 1944 (Feio 1944). An alternative morphology in which the lateral apodeme and ejaculatory canal is not lengthened posteriorly occurs in some species of *Withius* including the type species *W. piger* (Simon 1878) (Heurtault 1971) and in several African species (Mahnert 1988), as well as in *Aisthetowithius rossi* Beier 1967 (Mahnert 1988), *Girardwithius pumilus* Heurtault 1993 (Heurtault 1993) and *Ectromachernes lamottei* Vachon 1952 (Vachon 1952). Although it is possible that those species in which the lateral apodeme is triangular may represent a monophyletic group, it should be noted that the vast majority of withiids have yet to have their male genitalia described in detail, thus precluding any comprehensive statements regarding the utility of this feature.

Although the species described here in *Cystowithius* clearly form a monophyletic group, the disposition of the tactile seta of leg IV varies considerably in its position. The tactile seta is sub-distal in *C. smithersi* (TS = 0.75–0.77), *C. ecuadoricus* (TS = 0.74–0.75) and *C. colombicus* (TS = 0.77–0.79) but is only slightly distad of medial in *C. chamberlini* (TS = 0.59–0.61). This variation may diminish the usefulness of this character in distinguishing between different genera of Withiidae.

Species of *Cystowithius* are generally found at high altitudes with three species occurring above 3,000 m in the northern Andes in Colombia, Ecuador and Peru, and above 2,000 m in Mexico (Fig. 7).

Key to species of *Cystowithius*

- 1. Chelal hand smooth; setae on chelal hand only barely denticulate; tactile seta of tarsus IV situated sub-medially (TS = 0.59–0.61); males with sternal invaginations on sternites VI–VIII *C. chamberlini* new species
- Chelal hand evenly granulate; setae on chelal hand distinctly denticulate; tactile seta of tarsus IV situated sub-distally (TS = 0.74–0.79); males with sternal invaginations on sternites V–VIII 2
- 2(1). Larger species, e.g. chela (with pedicel) greater than 1.35 mm (Fig. 8) *C. smithersi* new species
- Smaller species, e.g. chela (with pedicel) less than 1.20 mm (Fig. 8) 3
- 3(2). Setae on tergite XI long and only slightly clavate (Fig. 27) *C. ecuadoricus* (Beier)
- Setae on tergite XI short and strongly clavate (Fig. 32) *C. colombicus* new species

Table 1.—Withiidae in which the male sternal invaginations are absent. Asterisk denotes the type species of the genus.

Taxon	Specimens examined	Museum	Locality	Remarks
<i>Balanowithius egregius</i> Beier 1959*	holotype ♂, paratype ♀	CAS	Pichilingue, Ecuador	Personal observation
<i>Cacodemonius satanas</i> (With 1908)				Dr M. Judson (in litt.)
<i>Cacodemonius segmentidentatus</i> (Balzan 1887)				Dr M. Judson (in litt.)
<i>Dolichowithius argentinus</i> Beier 1959	holotype ♂	CAS	Salta, Argentina	Personal observation
<i>Dolichowithius extensus</i> Beier 1932b	1 ♂, 1 ♀ syntypes	BMNH	La Moka, Venezuela	Personal observation
<i>Dolichowithius granulosis</i> Hoff, 1945	1 paratype ♂	AMNH	Guyana	Personal observation
<i>Ectromachernes mirabilis</i> Beier 1944*	holotype ♂	BMNH	Jemme Forest, Ethiopia	Personal observation
<i>Hyperwithius dawydoffi</i> Beier 1951	4 ♂ syntypes	NHMW	Cao Nguyên Lâm Viên (Plateau von Langbian), Lâm Dong, Vietnam	Personal observation
<i>Hyperwithius tonkinensis</i> Beier 1951	1 ♂, 1 ♀, 2 protonymphs syntypes	NHMW	Lau Chau, Lau Chau, Vietnam	Personal observation
<i>Juxtachelifer fructuosus</i> Hoff 1956*	paratypes ♂, ♀ and tritonymphs	AMNH	Santa Fe, New Mexico, U.S.A.	Personal observation
<i>Metawithius murrayi</i> (Pocock 1900)	1 ♂, 1 ♀ syntypes	BMNH	North West Point, Christmas Island, Australia	Personal observation
<i>Metawithius philippinus</i> Beier 1937	several ♂, ♀ syntypes	ZMB	Philippines	Personal observation
<i>Metawithius spiniventer</i> Redikorzev 1938	several ♂, ♀ specimens	NHMW	Cao Nguyên Lâm Viên (Plateau von Langbian), Lâm Dong, Vietnam	Personal observation
<i>Metawithius (Microwithius) yurii</i> (Redikorzev 1938)	1 ♂	NMV	Sertung Island, Indonesia	Personal observation
<i>Metawithius (Microwithius) tweediei</i> Beier 1955	2 ♂, 1 ♀ syntypes	NHMW	Telom Valley, Cameron Highlands, Pahang, Malaysia	Personal observation
<i>Nesowithius seychellensis</i> Beier 1940*	2 ♂ syntypes	BMNH	Praslin, Seychelles	Personal observation
New genus, similar to <i>Metawithius</i> Chamberlin 1931	several ♂, ♀ and tritonymphs	WAM	Manngarre Rainforest, Kakadu National Park, Northern Territory, Australia	Personal observation
<i>Parawithius nobilis</i> (With 1908)*	holotype ♂	BMNH	Bogotá, Colombia	Personal observation
<i>Parawithius nobilis</i> (With 1908)*	1 ♂	CAS	near Bogotá, Colombia	Personal observation

Table 1.—Continued.

Taxon	Specimens examined	Museum	Locality	Remarks
<i>Parawithius pseudorufus</i> Beier 1932b	holotype ♂	ZMB 29668	Paraguay	Personal observation
<i>Scotowithius helenae</i> Beier 1977*				Dr M. Judson (in litt.)
<i>Stenowithius angulatus</i> (Ellingsen 1906)	1 ♂	CAS (JC-906.01001)	no data	Personal observation
<i>Stenowithius bayoni</i> (Ellingsen 1910)	7 adult syntypes of <i>Stenowithius ugandanus</i> Beier 1932b	BMNH 1932.11.12.14–20	Kampala, Uganda	Personal observation
<i>Stenowithius duffeyi</i> Beier 1961	11 adult syntypes	BMNH 1964.8.17.2–12	Boatswain-bird Island, Ascension Island	Personal observation
<i>Thaumatoewithius tibialis</i> Beier 1940*	1 ♂, 2 ♀ syntypes	BMNH	Le Pouce, Mauritius	Personal observation
<i>Trichotowithius abyssinicus</i> Beier 1944*	1 ♂, 3 ♀ syntypes	BMNH	Jemme Forest, Ethiopia	Personal observation
<i>Victorowithius coniger</i> (Mahnert 1979)				Dr M. Judson (in litt.)
<i>Victorowithius rufeolus</i> (Beier 1959)	2 ♂ and ♀ syntypes	CAS	Pichilingue, Ecuador	Personal observation
<i>Victorowithius schlingeri</i> (Beier 1959)	holotype ♂	CAS	Tingo María, Monson Valley, Peru	Personal observation
<i>Victorowithius similis</i> (Beier 1959)	1 ♂ and 1 ♀ syntypes	CAS	10 miles N. of Trancas, Argentina	Personal observation
<i>Victorowithius venezuelanus</i> (Beier 1932b)	1 ♂ and 2 ♀ syntypes	BMNH	La Moka, Venezuela	Personal observation and Dr M. Judson (in litt.)
<i>Withius hispanus</i> (L. Koch 1873)	2 ♂	CAS (JC-511.04004–5)	Sardinia	Personal observation
<i>Withius piger</i> (Simon 1878)*	numerous specimens	WAM, CAS	Australia, Hawaii, Europe, North America, South America, India, etc.	Personal observation

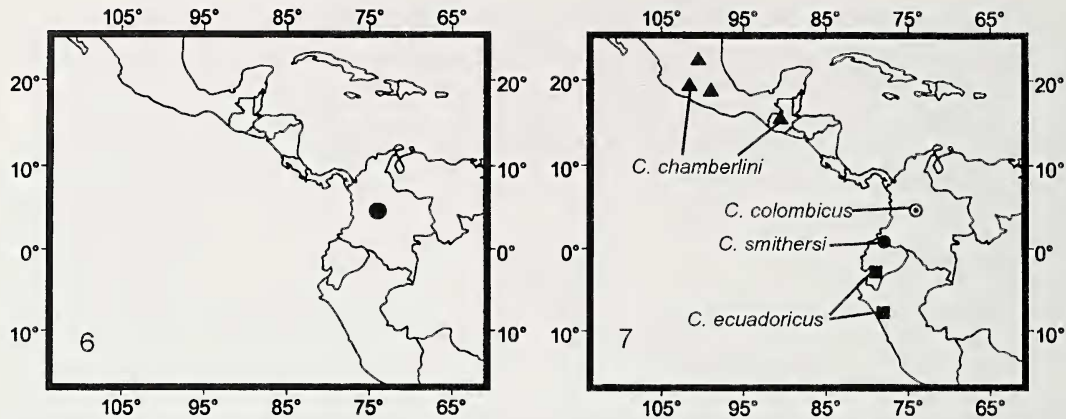
Cystowithius smithersi new species
Figs. 7–23

Material examined.—Holotype male, Volcán Chiles, ca. 15 km N. of Tulcán, *Carchi Province*, ECUADOR, 0°48'35.0"N, 77°57'15.0"W, altitude 3,600 m, August 1997, in leaf sheath of *Espeletia pycnophylla*, P. Smithers, A. Bond, M. Burne (WAM T54598). Paratypes: ECUADOR: *Carchi Province*: 3 males, 3 females (1 with brood-sac), 5 tritonymphs, same data as holotype (WAM T54599–54606); 1 male, 1 female, 1

tritonymph, same data as holotype (BMNH); 1 male, 1 female, 1 tritonymph, same data as holotype (PUCE); 1 male, 1 female, 1 tritonymph, same data as holotype (MHNG); 1 male, 1 female, 1 tritonymph, same data as holotype (MNHN).

Etymology.—The specific epithet honors Peter Smithers, University of Plymouth, who provided me with the opportunity to examine the specimens described here, and who first published upon the unusual biology of this species (Smithers et al. 2001).

Diagnosis.—*Cystowithius smithersi* differs



Figures 6–7.—Maps showing known distributions of species mentioned in the text: 6. *Parawithius nobilis*; 7. *Cystowithius* species.

from the other three species of the genus by its longer and more slender pedipalps, e.g. the chela (with pedicel) of *C. smithersi* is greater than 1.35 mm and the pedipalpal femur is greater than 0.90 mm. In addition, it differs from *C. chamberlini* in the evenly granulate chelal hand and the presence of male sternal invaginations on sternites V–VIII.

Description.—*Adults*: Color dark red-

brown; carapaceal metazone with paired pale spots; tergites with paler areas, usually surrounding setal areoles. Pedipalp (Fig. 16): all segments granulate, except for chelal fingers, which are smooth; dorsal setae generally strongly foliate; femur 4.93–5.43 (♂), 4.70–5.28 (♀), patella 4.04–4.45 (♂), 3.83–4.19 (♀), chela (with pedicel) 4.24–4.59 (♂), 3.88–4.18 (♀), chela (without pedicel) 4.04–4.35

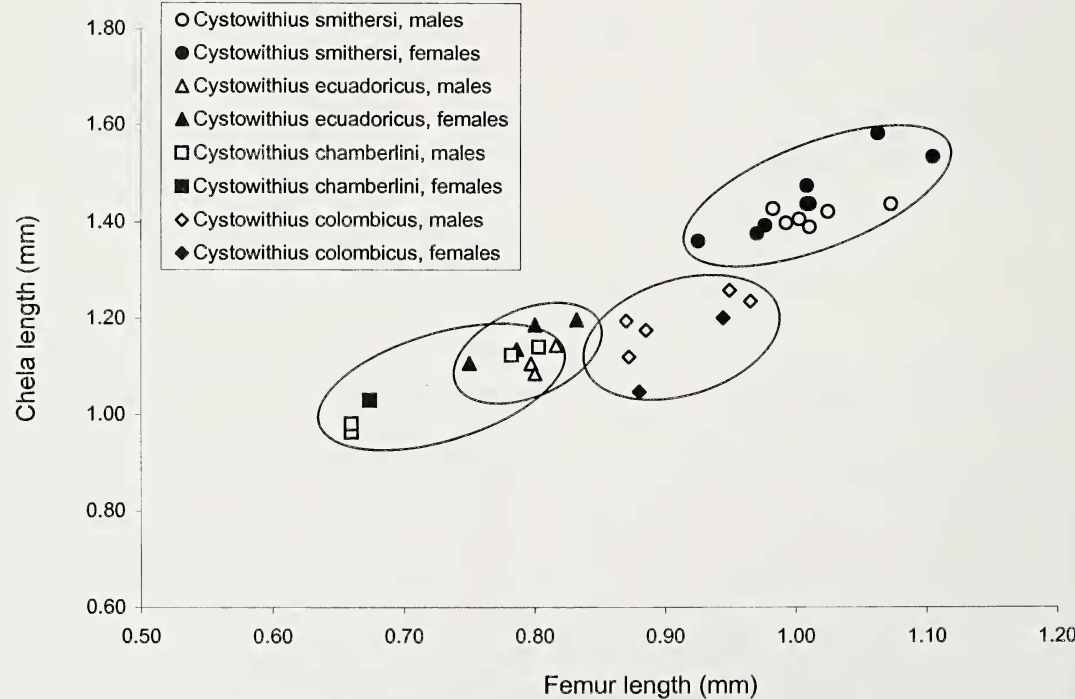


Figure 8.—Graph depicting pedipalpal chela (with pedicel) length versus pedipalpal femur length in *Cystowithius* species.

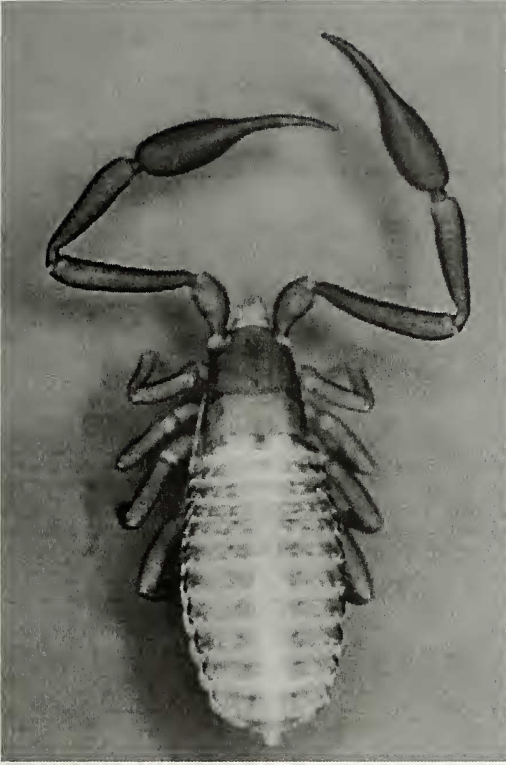
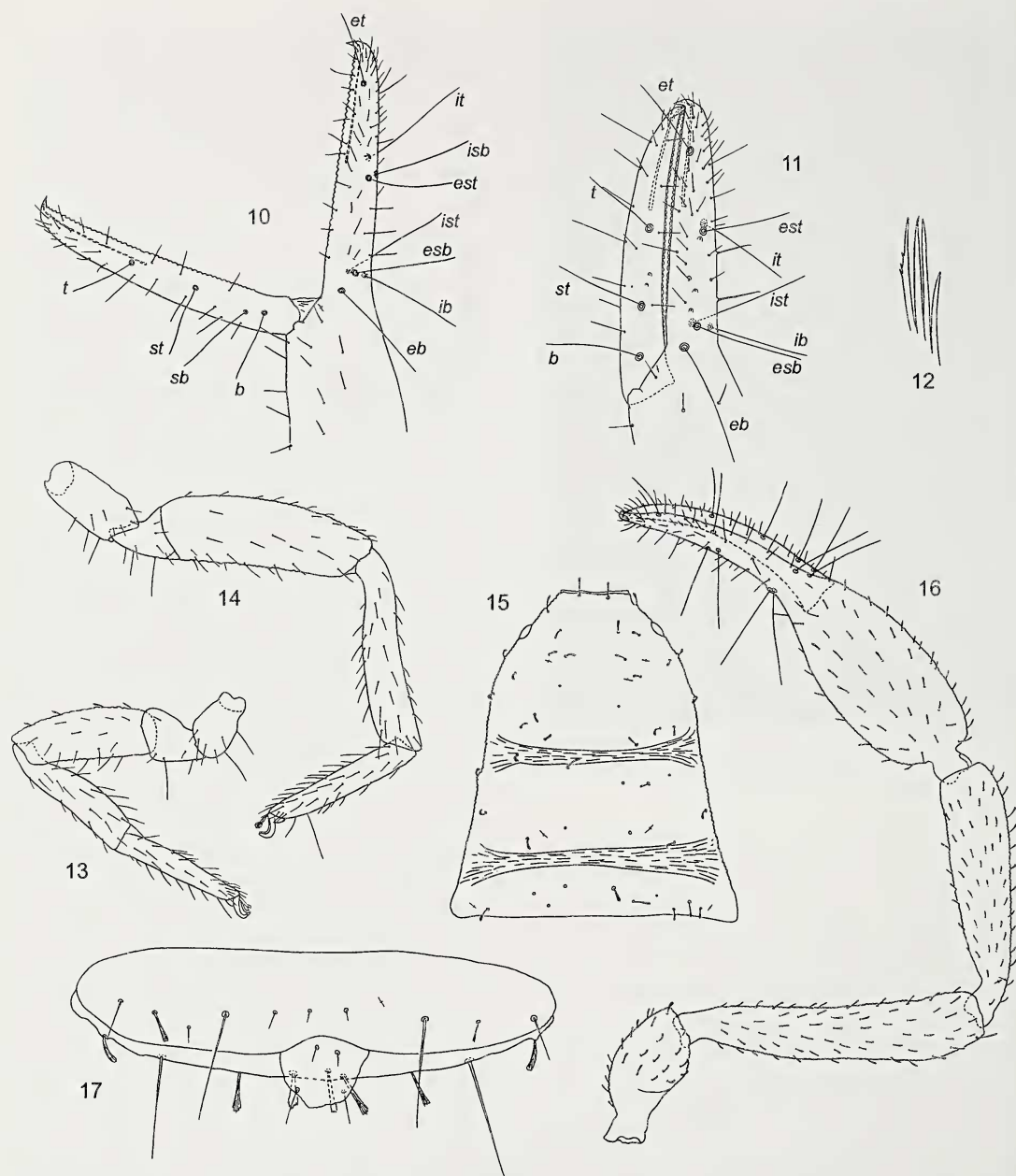


Figure 9.—*Cystowithius smithersi* new species, holotype male.

(♂), 3.71–4.00 (♀), hand 1.98–2.07 (♂), 1.74–1.95 (♀) times longer than broad, movable finger 1.04–1.15 (♂), 1.00–1.22 (♀) times longer than hand. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Fig. 10): *eb* and *esb* situated basally; *est*, *it* and *isb* grouped together sub-medially; *ist* and *ib* situated basally; *b* and *sb* situated near one another; *st* mid-way between *sb* and *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus near *est* in fixed finger and near *t* in movable finger. Chelal teeth triangular, slightly retrorse; fixed finger with 42 (♂), 43 (♀) teeth; movable finger with 49 (♂), 52 (♀) teeth; accessory teeth absent. Chelicera: with 5 setae on hand, all acuminate; movable finger with 1 subdistal seta; galea with 3 small terminal rami; flagellum of 4 blades (Fig. 12); serrula exterior with 19 (♂, ♀) blades; lamina exterior present. Carapace (Fig. 15) 0.97–1.09 (♂), 1.13–1.32 (♀) times longer than broad; lateral margins evenly convex, but posteriorly widened; with 2 non-corneate eyes; with ca. 44 setae, including 4 near

anterior margin and 10 near posterior margin; with 2 deep furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Tergites with distinct medial suture, sternites barely divided. Chaetotaxy of tergites I–XII: holotype ♂, 10: 9: 10: 13: 15: 15: 17: 18: 17: 13: 9 (including 2 tactile setae); 2; paratype ♀, 12: 10: 10: 17: 17: 16: 18: 18: 19: 16: 8: 2; mostly uniseriate but some tergites with a few setae placed anteriorly; all setae foliate. Chaetotaxy of sternites I–XII: holotype ♂, 13: (1)12(1): (2)12(2): 16: 19: 18[gl]: 16[gl]: 11[gl]: 9: 12: 2; paratype ♀, 15: (1)17(1): (2)12(2): 17: 20: 17[gl]: 17[gl]: 17[gl]: 14: 10: 2; sternites VII–IX with patches of glandular setae [gl], arranged ♂, ca. 75: 72: 60 respectively; ♀, 2: 2: 2, respectively; setae uniseriate and acuminate, except for lateral setae on sternite XI which are finely denticulate; glandular setae small and conical in shape; ♂ with paired invaginations on anterior margins of sternites V–VIII (Figs. 18, 19). Coxal chaetotaxy: paratype ♂, 10: 9: 10: 18; paratype ♀, 14: 13: 12: 22; pedipalpal coxa with 2 apical setae and very small suboral seta. Internal genitalia of male with lateral apodeme long and triangular (Fig. 21); of female with single oval median cribriform plate and 2 smaller lateral cribriform plates, and with poorly defined membranous spermathecal sac irregularly covered with pores; with 2 lateral hooked apodemes (Fig. 20). Legs (Figs. 13, 14): junction between femora and patellae I and II only slightly oblique; femur + patella of leg IV 3.80 (♂), 4.36 (♀) times longer than broad; tarsal tactile seta of leg IV situated subdistally, ca. 0.77 (♂), 0.75 (♀) of tarsus length; subterminal tarsal setae arcuate and acute; arolium slightly shorter than claws.

Dimensions (mm), males (females): Body length 2.40–2.75 (2.44–3.71). Pedipalps: trochanter 0.484–0.493/0.222–0.232 (0.464–0.515/0.224–0.246), femur 0.982–1.072/0.186–0.200 (0.925–1.104/0.193–0.215), patella 0.864–0.908/0.198–0.224 (0.789–0.960/0.206–0.229), chela (with pedicel) 1.392–1.440/0.307–0.340 (1.378–1.586/0.333–0.390), chela (without pedicel) 1.318–1.376 (1.306–1.517), hand length 0.634–0.672 (0.592–0.718), movable finger length 0.670–0.736 (0.656–0.776). Chelicera 0.250/0.128 (0.290/0.128), movable finger length 0.147 (0.197). Carapace 0.846–0.909/0.816–0.938 (0.845–0.944/0.640–0.832); eye diameter

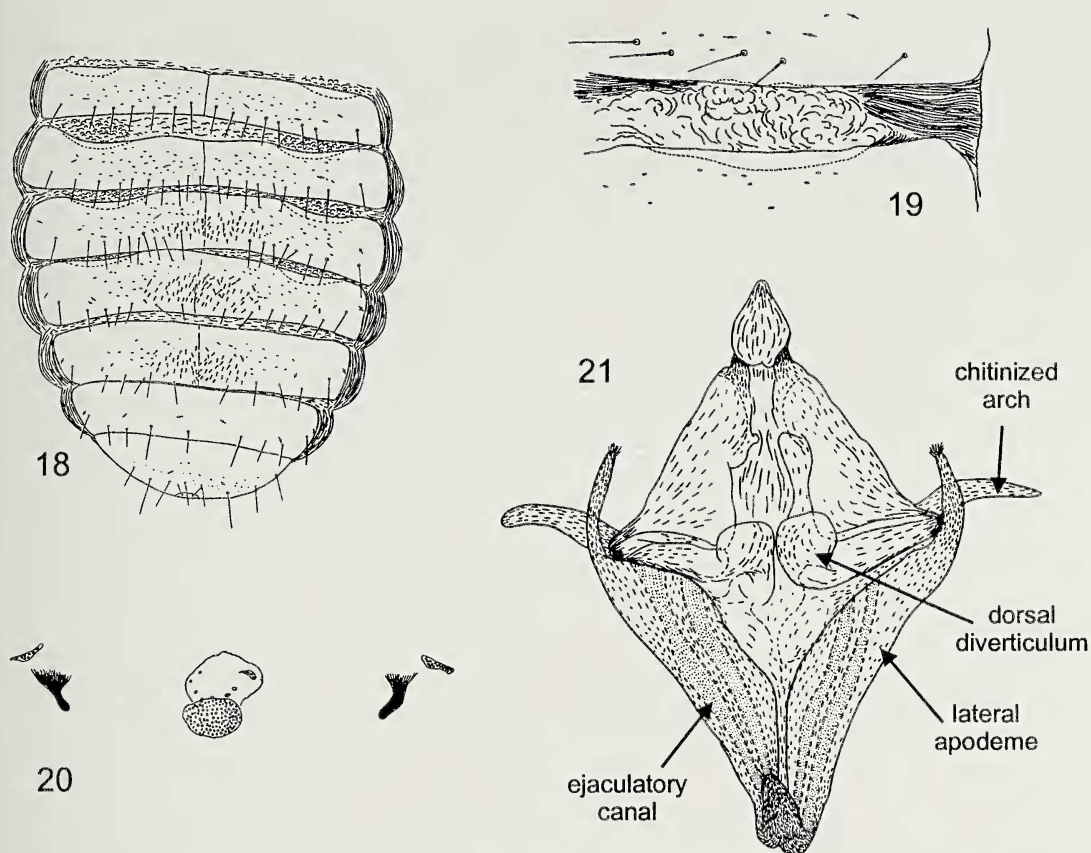


Figures 10–17.—*Cystowithius smithersi* new species, paratype male unless stated otherwise: 10. Left chela, lateral; 11. Left chela, lateral, paratype tritonymph; 12. Flagellum; 13. Left leg I; 14. Left leg IV; 15. Carapace, dorsal, paratype female; 16. Right pedipalp, dorsal, paratype female; 17. Posterior abdominal segments, ventral, holotype male. Trichobothrial abbreviations follow Chamberlin (1931) and Harvey (1992).

0.045–0.075 (0.045–0.076). Leg I: femur 0.192/0.154 (0.192/0.160), patella 0.445/0.159 (0.442/0.143), tibia 0.454/0.109 (0.454/0.103), tarsus 0.401/0.074 (0.435/0.074). Leg IV: femur + patella 0.802/0.211 (0.880/

0.202), tibia 0.653/0.125 (0.706/0.122), tarsus 0.481/0.087 (0.557/0.083), TS 0.371 (0.416).

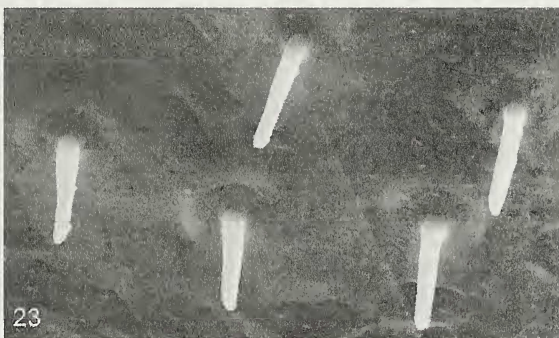
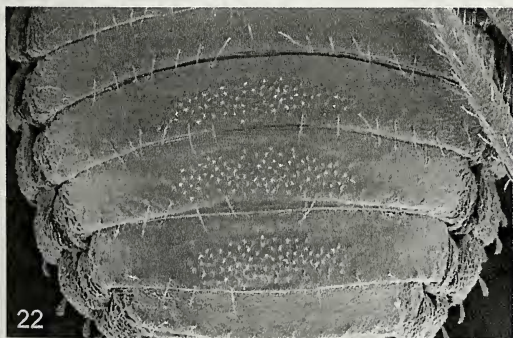
Tritonymphs: Color paler than adults. Pedipalp: trochanter 2.10, femur 4.47, patella 3.36, chela (with pedicel) 4.06, chela (without



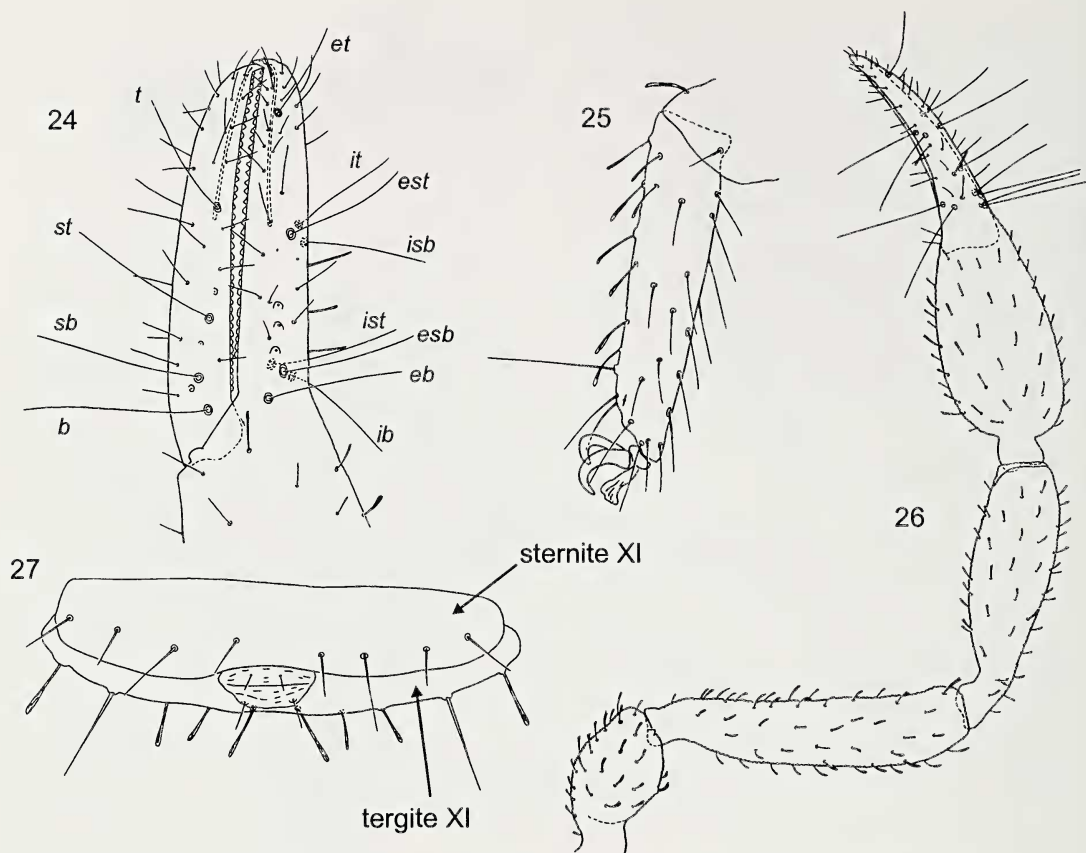
Figures 18–21.—*Cystowithius smithersi* new species, paratype male unless stated otherwise: 18. Posterior sternites, ventral; 19. Detail of invagination from left sternite VI; 20. Female genitalia, ventral, paratype female; 21. Male genitalia, dorsal.

pedicel) 3.83, hand 1.88 times longer than broad. Fixed chelal finger with 7 trichobothria, movable chelal finger with 3 trichobothria (Fig. 11); *isb* and *sb* absent. Carapace 1.08 times longer than broad; with 2 non-corneate eyes; with ca. 45 setae, including 4 near an-

terior margin and 7 near posterior margin; with 2 furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Chaetotaxy of tergites I–XII: 6: 6: 9: 9: 10: 10: 10: 10: 8: 7: 8: 2. Chaetotaxy of sternites I–XII: 4: (1)9(1): (2)7(2):



Figures 22–23.—*Cystowithius smithersi* new species, paratype male, scanning electron micrographs: 22. Posterior sternites, ventral; 23. Detail of glandular setae.



Figures 24–27.—*Cystowithius ecuadoricus* (Beier), lectotype male unless stated otherwise; 24. Left chela, lateral; 25. Left tarsus IV; 26. Right pedipalp, dorsal; 27. Posterior abdominal segments, ventral, paralectotype male. Trichobothrial abbreviations follow Chamberlin (1931) and Harvey (1992).

12: 11: 9: 10[gl]: 9[gl]: 8: 8 (including 2 tactile setae); 2; sternites VIII–IX each with 2 glandular setae [gl].

Dimensions (mm): Body length 2.54. Pedipalps: trochanter 0.384/0.183, femur 0.710/0.176, patella 0.592/0.176, chela (with pedicel) 1.120/0.276, chela (without pedicel) 1.058, hand length 0.518, movable finger length 0.550. Carapace 0.691/0.640.

Remarks.—*Cystowithius smithersi* occurs at a single locality in northern Ecuador where it was found among the leaf sheaths of the giant rosette plant *Espeletia pycnophylla* (Compositae). Smithers et al. (2001) found the giant rosette plant to harbor a wide variety of invertebrates that rely upon the peculiar leaf sheath microhabitat for permanent or temporary shelter. The leaf sheaths on the stems of these tall composites do not fall off when they die, but remain adhered to the stem to form a series of compact layers that insulate the plant

from the very low nocturnal temperatures that occur in the area. The invertebrate communities in a population of *E. pycnophylla* was found to be dominated by Araneae, Coleoptera, larval Lepidoptera, Diptera, Hymenoptera and Pseudoscorpiones. The pseudoscorpions represented 9.9% of the day-time samples and 9.5% of the night-time samples, and were found to be more abundant in the central sections of the leaf sheath (Smithers et al. 2001).

Cystowithius ecuadoricus (Beier 1959)
NEW COMBINATION, NEW STATUS
Figs. 7, 8, 24–27

Parawithius (*Parawithius*) *nobilis ecuadoricus*
Beier 1959: 217–218, fig. 26; Harvey 1991: 651.

Material examined.—Lectotype male (present designation), Lago Zurucuchu, 11 miles W. of Cuenca, Azuay Province, ECUADOR [2°53'S, 78°59'W], 16 February

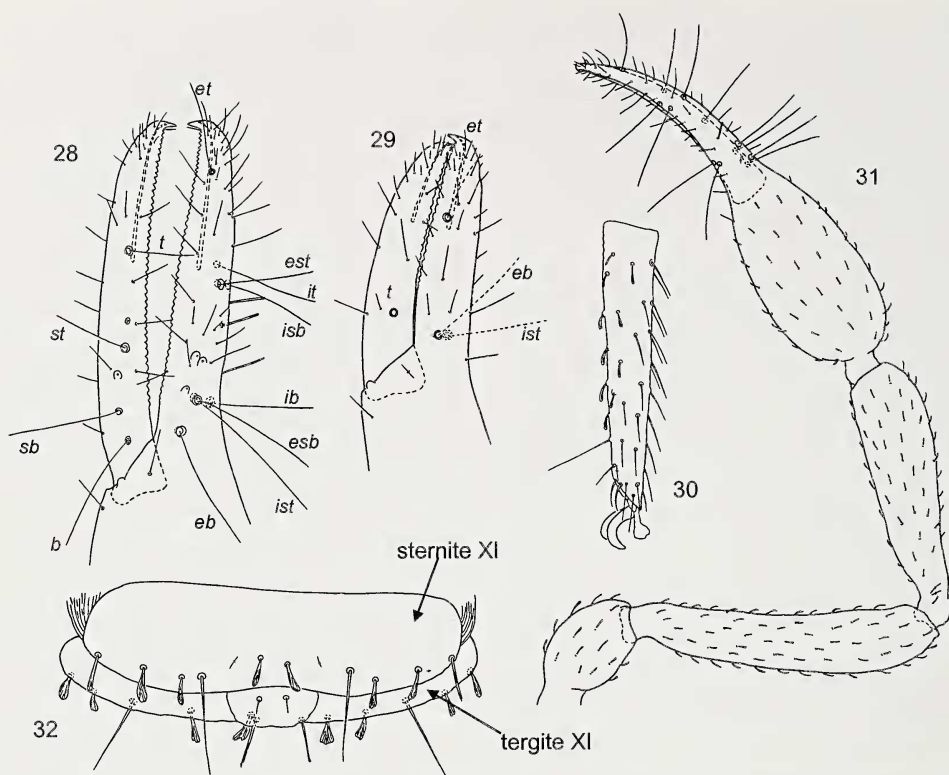
1955, E.I. Schlinger and E.S. Ross (CAS, Type No. 8691). Paralectotypes: ECUADOR: *Azuay Province*: 1 male, 2 females, same data as lectotype (CAS); 1 male, 1 female, same data (NHMW). PERU: *La Libertad*: 1 female, Huamachuco [7°48'S, 78°04'W], 3,200 m, 18 September 1955, under Stein [under stone], Weyrauch (NHMW).

Diagnosis.—*Cystowithius ecuadoricus* is most similar to *C. colombicus* as both lack the smooth chelal hand found in *C. chamberlini*, and are slightly smaller than *C. smithersi* [e.g. chela (with pedicel) less than 1.20 mm in length (Fig. 8)]. *Cystowithius ecuadoricus* differs from *C. colombicus* in the possession of long, strongly denticulate setae on the chelal hand, and the long, weakly clavate setae on tergite XI and sternite XI.

Description.—*Adults*: Color dark red-brown; carapaceal metazone with paired pale spots. Pedipalp (Fig. 26): all segments granulate, except for chelal fingers, which are smooth; dorsal setae generally strongly foliate; trochanter 1.81–2.04 (♂), 1.78–1.98 (♀), femur 4.47–4.74 (♂), 4.19–4.47 (♀), patella 3.18–3.47 (♂), 3.06–3.35 (♀), chela (with pedicel) 3.65–4.01 (♂), 3.44–3.72 (♀), chela (without pedicel) 3.43–3.78 (♂), 3.29–3.53 (♀), hand 1.74–1.96 (♂), 1.61–1.71 (♀) times longer than broad, movable finger 0.86–1.11 (♂), 0.90–1.13 (♀) times longer than hand. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Fig. 24): *eb* and *esb* situated basally; *est*, *it* and *isb* grouped together sub-medially; *ist* and *ib* situated basally; *b* and *sb* situated near one another; *st* slightly closer to *sb* than to *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus near *est* in fixed finger and near *t* in movable finger. External margin of fixed finger with three sense-spots situated linearly between *esb* and *est*; external margin of movable finger with three sense-spots, one situated slightly basal to *sb*, another between *sb* and *st*, and the other slightly anterior to *st*. Chelal teeth strongly triangular, slightly retrorse, becoming rounded basally; fixed finger with 34 (♂), 36 (♀) teeth; movable finger with 39 (♂), 40 (♀) teeth; accessory teeth absent. Chelicera: with 5 setae on hand, *bs* and *sbs* dentate; movable finger with 1 submedial seta; galea short with 2 or 3 small terminal rami; flagellum of 4 blades; serrula exterior with 18 blades (♂, ♀);

lamina exterior present. Carapace 1.00–1.28 (♂), 1.10–1.28 (♀) times longer than broad; lateral margins evenly convex, but posteriorly widened; with 2 non-corneate eyes; with ca. 50 (♂), 54 (♀) setae, including 4 near anterior margin and 6 near posterior margin; with 2 deep furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Tergites with distinct medial suture, sternites faintly divided. Chaetotaxy of tergites I–XII: ♂, 7: 8: 9: 10: 10: 11: 12: 12: 11: 12: 11 (including 2 tactile setae): 2; ♀, 9: 10: 9: 10: 13: 13: 14: 14: 13: 12: 8 (including 2 tactile setae): 2; mostly uniseriate but some tergites with a few setae placed anteriorly; all setae foliate. Chaetotaxy of sternites I–XII: ♂, 13: (1)10(1): (2)13(2): 19: 21: 16[gl]: 10[gl]: 10[gl]: 8[gl]: 8 (including 2 tactile setae): 2; ♀, 13: (1)12(1): (2)13(2): 14: 17: 18: 16[gl]: 13[gl]: 10: 8 (including 2 tactile setae): 2; sternites VI–IX of ♂ with patches of glandular setae [gl], arranged 6: 42: 10: 8 (lectotype) respectively; sternites VII–VIII of ♀ with glandular setae [gl], arranged 2: 2 respectively; setae uniseriate and acuminate, except for smaller setae on sternite XI which are lightly denticulate; glandular setae small and conical in shape; ♂ with paired invaginations on anterior margins of sternites V–VIII. Coxal chaetotaxy: ♂, 10: 9: 13: 15, ♀, 10: 11: 10: 18; pedipalpal coxa with 2 apical setae and very small sub-oral seta. Internal genitalia not observed in detail, but apparently very similar to that of *C. smithersi*. Legs: junction between femora and patellae I and II only slightly oblique; femur + patella of leg IV 2.93 (♂), 3.04 (♀) times longer than broad; tarsal tactile seta of leg IV situated sub-distally (Fig. 25), 0.74–0.75 of tarsus length; subterminal tarsal setae arcuate and acute; arolium slightly shorter than claws.

Dimensions (mm), males (females): Body length 2.16–2.29 (2.06–2.93). Pedipalps: trochanter 0.384–0.403/0.198–0.212 (0.384–0.410/0.194–0.230), femur 0.797–0.816/0.168–0.179 (0.750–0.410/0.173–0.191), patella 0.674–0.688/0.195–0.212 (0.637–0.707/0.199–0.224), chela (with pedicel) 1.085–1.144/0.276–0.297 (1.107–1.198/0.311–0.345), chela (without pedicel) 1.018–1.106 (1.046–1.136), hand length 0.502–0.575 (0.501–0.589), movable finger length 0.497–0.558 (0.528–0.595). Chelicera 0.205/0.109 (0.226/0.128), movable finger length 0.148



Figures 28–32.—*Cystowithius colombicus* new species, holotype male, unless stated otherwise: 28. Left chela, lateral; 29. Left chela, lateral, paratype protonymph; 30. Right pedipalp, dorsal; 31. Left tarsus IV; 32. Posterior abdominal segments. Trichobothrial abbreviations follow Chamberlin (1931) and Harvey (1992).

(0.144). Carapace 0.749–0.800/0.624 (0.784–0.861/0.632–0.760) (width at medial area); eye diameter 0.070 (0.075–0.080). Leg I: femur 0.154/0.160 (0.162/0.155), patella 0.275/0.150 (0.328/0.145), tibia 0.338/0.098 (0.319/0.095), tarsus 0.304/0.067 (0.287/0.110). Leg IV: femur + patella 0.600/0.205 (0.608/0.200), tibia 0.485/0.116 (0.479/0.111), tarsus 0.346/0.074 (0.347/0.073), TS 0.256 (0.259).

Remarks.—Beier (1959) apparently overlooked the sternal invaginations on the male specimens of *P. nobilis ecuadoricus* and simply described the taxon as a subspecies of the somewhat similar looking *P. nobilis*. Despite the superficial resemblances between the two forms it is clear that they not only differ at the species level but also at the generic level due to the lack of sternal invaginations in *P. nobilis*. In his original publication, Beier (1959) did not select a primary type specimen from the original syntype series and merely listed six adults from Lago Zurucuchu as “typen” and a further female from Huamachuco

as “paratype”. I hereby select a male from the type locality as the lectotype. *Cystowithius ecuadoricus* is known from high elevation localities in Ecuador and Peru.

Cystowithius colombicus new species

Figs. 7, 8, 28–32

Material examined.—Holotype male, Paramo de Monserrate [7 km NE of Bogotá, 4°37'N, 74°04'W], Cundinamarca, COLOMBIA, 3,200–3,300 m, [H.] Stürm (NHMW). Paratypes: COLOMBIA: Cundinamarca: 1 female, same data as holotype (NHMW); 3 males, 1 female, 2 protonymphs, Paramo de Monserrate [7 km NE of Bogotá, 4°37'N, 74°04'W], 3,200 m, 1968, [H.] Stürm (NHMW); 1 male, same data (WAM T54607).

Etymology.—The specific epithet is an adjective derived from the country in which the specimens occur.

Diagnosis.—*Cystowithius colombicus* most closely resembles *C. ecuadoricus*, as both lack the smooth chelal hand found in *C. chamber-*

lini and are slightly smaller than *C. smithersi* [e.g. chela (with pedicel) less than 1.20 mm in length (Fig. 8)]. *Cystowithius colombicus* differs from *C. ecuadoricus* in the lack of long, strongly denticulate setae on the chelal hand (Fig. 31), and the long, strongly clavate setae on tergite XI and sternite XI (Fig. 32).

Description.—*Adults*: Color dark red-brown; carapaceal metazone with paired pale spots. Pedipalp (Fig. 31): all segments granulate, except for chelal fingers, which are smooth; dorsal setae generally strongly foliate; trochanter 1.89–2.10 (♂), 1.93 (♀), femur 4.78–5.25 (♂), 4.99–5.37 (♀), patella 3.88–4.46 (♂), 3.70–4.31 (♀), chela (with pedicel) 3.80–4.04 (♂), 3.24–3.63 (♀), chela (without pedicel) 3.60–3.81 (♂), 3.22–3.43 (♀), hand 1.63–1.97 (♂), 1.67–1.84 (♀) times longer than broad, movable finger 0.90–1.24 (♂), 0.90–0.92 (♀) times longer than hand. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Fig. 28): *eb* and *esb* situated basally; *est*, *it* and *isb* grouped together sub-medially; *ist* and *ib* situated basally; *b* and *sb* situated near one another; *st* slightly closer to *sb* than to *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus near *est* in fixed finger and near *t* in movable finger. External margin of fixed finger with three sense-spots situated between *esb* and *est*; external margin of movable finger with one sense-spot situated between *sb* and *st*; external margin of movable finger also with peculiar small structure slightly anterior to *st* that contains three small nubbins. Chelal teeth strongly triangular, slightly retrorse, becoming rounded basally; fixed finger with 42 (♂), 44 (♀) teeth; movable finger with 42 (♂), 47 (♀) teeth; accessory teeth absent. Chelicera: with 5 setae on hand, *bs* and *sbs* dentate; movable finger with 1 submedial seta; galea short with 3 or 4 small terminal rami; flagellum of 4 blades; serrula exterior with 17 (♂, ♀) blades; lamina exterior present. Carapace 1.43 (♂), 1.29 (♀) times longer than broad; lateral margins evenly convex, but posteriorly widened; with 2 non-corneate eyes; with ca. 58 (♂), 61 (♀) setae, including 4 near anterior margin and 6 near posterior margin; with 2 deep furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Tergites with distinct medial suture, sternites faintly divided. Chaetotaxy of ter-

gites I–XII: ♂, 6: 7: 9: 10: 13: 14: 14: 15: 16: 13: 12 (including 2 tactile setae): 2; ♀, 8: 8: 9: 13: 16: 16: 16: 17: 15: 16: 12 (including 2 tactile setae): 2; mostly uniseriate but some tergites with a few setae placed anteriorly; all setae strongly foliate. Chaetotaxy of sternites I–XII: ♂, 8: (1)10(1): (2)10(2): 12: 11: 12[glsl]: 10[glsl]: 10[glsl]: 8[glsl]: 10 (including 2 tactile setae): 2; ♀, 14: (1)10(1): (2)10(2): 13: 13: 13: 14[glsl]: 13[glsl]: 9: 12 (including 2 tactile setae): 2; sternites VII–IX of ♂ with patches of glandular setae [glsl], arranged ca. 20: 27: 13 respectively; sternites VIII–IX of ♀ with glandular setae [glsl], arranged 2: 2 respectively; setae uniseriate and acuminate, except for smaller setae on sternite XI which are strongly denticulate (Fig. 32); glandular setae small and conical in shape; ♂ with paired invaginations on anterior margins of sternites VI–VII. Coxal chaetotaxy: ♂, 10: 11: 9: 17, ♀, 10: 9: 11: 20; pedipalpal coxa with 2 apical setae and very small sub-oral seta. Internal genitalia not observed in detail, but apparently very similar to that of *C. smithersi*. Legs: junction between femora and patellae I and II only slightly oblique; femur + patella of leg IV 4.06 (♂), 4.00 (♀) times longer than broad; tarsal tactile seta of leg IV situated sub-distally (Fig. 30), 0.77 (♂), 0.79 (♀) of tarsus length; subterminal tarsal setae arcuate and acute; arolium slightly shorter than claws.

Dimensions (mm), males (females): Body length 2.00–2.11 (2.42). Pedipalps: trochanter 0.398–0.432/0.198–0.218 (0.422/0.219), femur 0.870–0.965/0.166–0.202 (0.880–0.944/0.164–0.189), patella 0.768–0.883/0.186–0.206 (0.750–0.800/0.174–0.216), chela (with pedicel) 1.120–1.260/0.277–0.332 (1.048–1.202/0.289–0.371), chela (without pedicel) 1.056–1.195 (0.992–1.196), hand length 0.498–0.600 (0.531–0.621), movable finger length 0.493–0.606 (0.480–0.570). Chelicera 0.221/0.109 (0.262/0.129), movable finger length 0.166 (0.160). Carapace 0.736/0.515 (0.840/0.650) (width at medial area); eye diameter 0.038 (0.083). Leg I: femur 0.173/0.138 (0.191/0.139), patella 0.360/0.135 (0.395/0.146), tibia 0.358/0.093 (0.381/0.097), tarsus 0.338/0.064 (0.358/0.075). Leg IV: femur + patella 0.674/0.166 (0.768/0.192), tibia 0.538/0.105 (0.604/0.122), tarsus 0.406/0.072 (0.461/0.090), TS 0.311 (0.365).

Protonymphs: Color very pale yellow-brown. Pedipalp: trochanter 1.75 femur 3.05,

patella 3.24, chela (with pedicel) 3.72, chela (without pedicel) 3.55, hand 1.78 times longer than broad. Fixed chelal finger with 3 trichobothria, movable chelal finger with 1 trichobothrium (Fig. 29): *eb*, *et*, *ist*, and *t* present; *et* sub-distal, *eb*, *ist* and *t* sub-basal. Carapace 1.00 times longer than broad; with 2 small non-corneate eyes; with 16 setae, including 4 near anterior margin and 4 near posterior margin; with 1 shallow furrow, situated near posterior carapaceal margin. Tergal and sternal chaetotaxy indeterminate due to poor preservation of specimens.

Dimensions (mm): Body length 0.82. Pedipalps: trochanter 0.198/0.113, femur 0.336/0.110, patella 0.269/0.083, chela (with pedicel) 0.548/0.083, chela (without pedicel) 0.523, hand length 0.261, movable finger length 0.258. Carapace 0.390/0.390.

Remarks.—*Cystowithius colombicus* is known from a single high altitude locality in Colombia, and the type specimens are labelled "Paramo Monserrate" or "Paramo de Monserrate". As indicated by Cooke (1972), the locality Cerro Monserrate is situated on the outskirts of Bogotá and is dominated by páramo, a high elevation habitat type that is found above the continuous forest line and below the perpetual snow line. The specimens were labeled by M. Beier as the types of a new species, but this name remains unpublished.

The movable chelal finger of *C. colombicus* bears a small pore slightly anterior to trichobothrium *st* that has three small nubbins situated within it.

Cystowithius chamberlini new species
Figs. 7, 8, 33–36

Material examined.—Holotype male, Matlalpan (see Remarks), San Luis Potosí, MEXICO, 5 April 1942, bosque, bajo cortezas (forest, under bark), F. Bonet (CAS, JC-1918.01001). Paratypes: MEXICO: San Luis Potosí: 5 males, 2 tritonymphs, same data as holotype (CAS, JC-1918.01002–7, 2 males on slides, remainder in ethanol); Morelos: 1 male, 1 female, Oaxtepec [18°54'N, 98°58'W], 24 August 1941, terreno cultivado, tronco podrido (cultivated land, rotten trunk), J. Alvarez (CAS, JC-1897.01001–2); Michoacan: 1 male, Pátzcuaro [19°31'N, 101°36'W], 1 September 1941, terrenos cultivados, hierbas

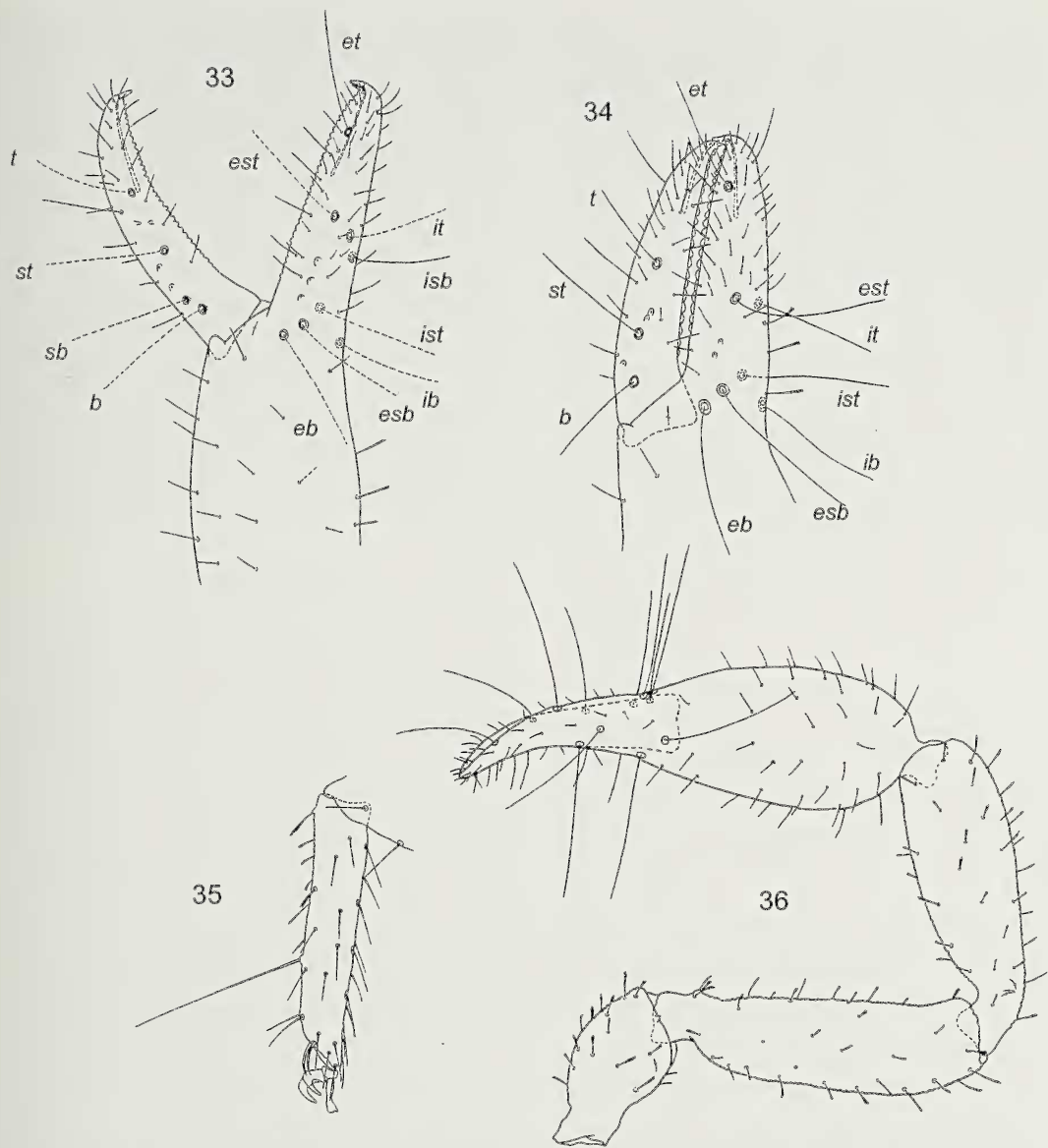
podridas (cultivated land, rotten herbs), T. Alvarez (CAS, JC-1780.01001).

Other material: GUATEMALA: 1 ♂, no other data, other than 'ex orchids' (UCD).

Etymology.—The specific name honors Joseph C. Chamberlin (1898–1962) who first recognized this peculiar genus of pseudoscorpion.

Diagnosis.—*Cystowithius chamberlini* differs from other *Cystowithius* species in the possession of a smooth chelal hand.

Description.—*Adults*: Color red-brown; carapaceal metazone with small paired pale spots; tergites with median section pale forming a longitudinal line along length of body. Pedipalp (Fig. 36): all segments granulate, except for chela which is smooth; setae generally strongly foliate, except for setae on chelal hand which are only long and slightly denticulate; trochanter 1.69–2.02 (♂), 1.96 (♀), femur 3.55–3.91 (♂), 3.62 (♀), patella 2.72–3.30 (♂), 3.30 (♀), chela (with pedicel) 3.13–3.28 (♂), 3.10 (♀), hand 1.62–1.79 (♂), 1.68 (♀) times longer than broad, movable finger 0.86–1.00 (♂), 0.87 (♀) times longer than hand. Fixed chelal finger with 8 trichobothria, movable chelal finger with 4 trichobothria (Fig. 33): *eb* and *esb* situated basally; *est*, *it* and *isb* grouped together sub-medially; *ist* and *ib* situated basally; *b* and *sb* situated near one another; *st* slightly closer to *sb* than to *t*. Venom apparatus present in both chelal fingers, venom ducts long, terminating in nodus ramosus mid-way between *est* and *et* in fixed finger and near *t* in movable finger. Chelal teeth triangular, slightly retrorse and contiguous; fixed finger with? (♂), 36 (♀) teeth; movable finger with? (♂), 37 (♀) teeth; accessory teeth absent. Chelicera: with 5 setae on hand, *bs* and *sbs* dentate; movable finger with 1 subdistal seta; galea long with 3 or 4 small terminal rami; flagellum of 4 blades, the most distal blade with several serrations on leading edge, other blades smooth; serrula exterior with 17 (♂), 16 (♀) blades; lamina exterior present. Carapace 0.98–1.25 (♂), 1.19 (♀) times longer than broad; lateral margins evenly convex, but posteriorly widened; with 2 non-corneate eyes; with ca. 51 (♂), 44 (♀) setae, including 4 near anterior margin and 6 near posterior margin; with 2 deep furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow.



Figures 33–36.—*Cystowithius chamberlini* new species, holotype male unless stated otherwise: 33. Left chela, lateral; 34. Left chela, lateral, paratype tritonymph; 35. Right tarsus IV; 36. Right pedipalp, dorsal. Trichobothrial abbreviations follow Chamberlin (1931) and Harvey (1992).

Tergites I–X with medial suture, sternites IV–X with faint medial suture. Chaetotaxy of tergites I–XII: male holotype, 6: 7: 8: 10: 10: 11: 9: 10: 10: 10: 12 (including 2 tactile setae): 2; ♀ paratype, 8: 10: 11: 14: 15: 14: 14: 14: 15: 15: 10 (including 2 tactile setae): 2. mostly uniseriate but some tergites with a few setae placed anteriorly; all setae except tactile setae foliate. Chaetotaxy of sternites I–XII: male holotype, 9: (1)10(0): (2)12(2): 18: 19: 10[gls]: 9[gls]: 11[gls]: 10[gls] (including 2

tactile setae): 10 (including 4 tactile setae): 2; female paratype, 12: (1)10(1): (2)12(2): 18: 17: 14: 17: 18: 11 (including 2 tactile setae): 12 (including 4 tactile setae): 2; sternites VI–IX of ♂ with patches of glandular setae [gls], arranged 58: ca. 100: 83: 51, respectively; sternite VIII–IX of ♀ with glandular setae [gls] arranged 2: 2; all setae uniseriate and acuminate, except for smaller setae on sternite XI which are denticulate; glandular setae small and conical in shape; ♂ with paired in-

vaginations on anterior margins of sternites VI-VIII. Coxal chaetotaxy: male holotype, 10: 9: 12: 24; female paratype 9: 10: 8: 17; pedipalpal coxa with 2 apical setae and very small sub-oral seta. Internal genitalia of male similar to that of *C. smithersi*; of female with single oval median cribriform plate and 2 smaller lateral cribriform plates, and with poorly defined membranous spermathecal sac irregularly covered with pores; with 2 lateral hooked apodemes. Legs: junction between femora and patellae I and II only slightly oblique; femur + patella of leg IV 2.74 (♂), 3.02 (♀) times longer than broad; tarsal tactile seta of leg IV situated sub-distally (Fig. 35), ca. 0.61 (♂), 0.59 (♀) of tarsus length; sub-terminal tarsal setae arcuate and acute; arolium slightly shorter than claws.

Dimensions (mm), males (females): Body length ca. 2.20 (ca. 2.53). Pedipalps: trochanter 0.344–0.402/0.179–0.225 (0.357/0.182), femur 0.660–0.782/0.179–0.208 (0.674/0.186), patella 0.610–0.736/0.205–0.224 (0.656/0.199), chela (with pedicel) 0.964–1.141/0.275–0.333 (1.030/0.314), chela (without pedicel) 0.902–1.076 (0.974), hand length 0.488–0.566 (0.528), movable finger length 0.422–0.541 (0.458). Chelicera ? (?), movable finger length ? (?). Carapace 0.698–0.768/0.560–0.712 (0.728/0.612) (width at medial area); eye diameter 0.040–0.051 (0.048). Leg I: femur 0.163/0.144 (0.163/0.141), patella 0.352/0.137 (0.341/0.138), tibia 0.354/0.088 (0.324/0.085), tarsus 0.318/0.060 (0.326/0.065). Leg IV: femur + patella 0.621/0.227 (0.640/0.212), tibia 0.506/0.122 (0.496/0.149), tarsus 0.384/0.074 (0.519/0.077), TS 0.234 (0.232).

Tritonymphs: Color paler than adults. Pedipalp: trochanter 1.85, femur 3.15, patella 2.89, chela (with pedicel) 3.75, chela (without pedicel) 3.49, hand 2.04 times longer than broad. Fixed chelal finger with 7 trichobothria, movable chelal finger with 3 trichobothria (Fig. 34); *isb* and *sb* absent. Carapace 0.96 times longer than broad; with 2 non-corneate eyes; with ca. 51 setae, including 4 near anterior margin and 6 near posterior margin; with 2 furrows, the posterior furrow slightly closer to posterior carapaceal margin than to median furrow. Chaetotaxy of tergites I–XII: 6: 6: 8: 9: 9: 10: 10: 10: 10: 10: 8 (including 2 tactile setae); 2. Chaetotaxy of sternites I–XII: 3: (1)8(1): (2)7(2): 11: 9: 10: 11[gl]:

12[gl]: 10 (including 2 tactile setae): 12 (including 4 tactile setae): 2; sternites VIII–IX each with 2 glandular setae [gl].

Dimensions (mm): Body length 1.76. Pedipalps: trochanter 0.243/0.131, femur 0.438/0.139, patella 0.445/0.154, chela (with pedicel) 0.739/0.197, chela (without pedicel) 0.688, hand length 0.402, movable finger length 0.342. Carapace 0.576/0.600.

Remarks.—*Cystowithius chamberlini* has been found in central and southern Mexico, as well as in Guatemala, where collection data indicates that it occurs 'under bark' and 'ex orchids'. I was unable to locate the locality 'Matlalpan' and the possibility exists that J.C. Chamberlin incorrectly transcribed the locality data after he received the specimens from F. Bonet.

DISCUSSION

Members of the family Withiidae have a number of defining features, the most obvious being the presence of patches of glandular setae on some sternites of the males, and occasionally, of females and nymphs. However there are three genera currently attributed to the family that lack such setae: *Protowithius* Beier 1955, *Juxtachelifer* Hoff 1956 and *Termitowithius* Muchmore 1990. *Juxtachelifer* was originally named by Hoff (1956) for the North American species *J. fructuosus* Hoff 1956 and placed in its own tribe (*Juxtacheliferini*) within the Cheliferidae. Muchmore (1990a) transferred the genus to the Withiidae as it shared with other withiids the perpendicular suture line between femur and patella I; all other cheliferoids (Cheliferidae, Chernetidae and Atemnidae) possess a strongly oblique suture line (Harvey 1992). I have examined several male and female paratypes of *J. fructuosus* (lodged in AMNH) and while the general morphology of the species is strongly reminiscent of other withiids, the morphology of the male genitalia has features that appear to be shared with some cheliferids as intimated by Hoff (1956). Just one year prior to the description of *Juxtachelifer*, Beier (1955) named *Protowithius* from the Juan Fernandez Islands which he placed in the *Protowithiini*. Like *Juxtachelifer*, males of both species lacked the glandular setae characteristic of other withiids. A close relationship between *Juxtachelifer* and *Protowithius* has yet to be established but there are certain similarities

between the two genera that may indicate that they belong to their own clade. The third withiid that is known to lack male sternal glandular setae is *Termitowithius* from Tanzania. Muchmore (1990b) discussed the peculiar features of this genus. The polarity of the acquisition of the glandular setae will have ramifications for the phylogeny and classification of the Withiidae. If the absence of glandular setae is treated as plesiomorphic, then these three genera may lie outside the remainder of the family. In this case, *Protowithius*, *Juxtachelifer* and *Termitowithius* are not grouped into a monophyletic group, but the remaining withiid genera form a clade for which the name Withiinae would be used. If the absence of glandular setae is treated as an apomorphy then these three genera may be deemed to form a clade (for which the name Protowithiini is the oldest) within the Withiidae if it can be shown that the glandular setae have been lost just once. If the losses are deemed to be independent of each other, then an alternative classification will be required. In addition, there seems to be little support for either of the two withiid subfamilies currently recognized, Withiinae and Paragoniochernetinae, although the unusual morphology of the posterior carapacial margin of the Paragoniochernetinae (containing the African genera *Cyrtowithius* Beier 1955, *Ectromachernes* Beier 1944, *Paragoniochernes* Beier 1932, *Pseudatemnus* Beier 1947 and *Pseudochernes* Beier 1954) seems to suggest that this small subfamily of just 10 species may be monophyletic. The monophyly of the Withiinae remains to be proven and the status of many of the 31 genera that have been attributed to the group is uncertain. In this paper I have attempted to clarify the status of the New World genus *Parawithius* by redescribing the type species *P. nobilis*, by returning *Victorowithius* to full generic level and naming a distinctive new genus, *Cystowithius*. While it may seem imprudent to add yet another genus to the Withiidae, the peculiar and highly autapomorphic sternal invaginations found in the four species of *Cystowithius* suggests that the group is unequivocally monophyletic. Nevertheless, the relationships of the genus are presently difficult to ascertain, as the generic composition and interrelationships of the Withiidae is still uncertain.

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LITERATURE CITED

- Balzan, L. 1887. Chernetidae nonnullae Sud-Americanae, II. Asuncion.
- Beier, M. 1932a. Pseudoscorpionidea II. Subord. C. Cheliferinea. Tierreich 58:i-xxi, 1-294.
- Beier, M. 1932b. Zur Kenntnis der Cheliferidae (Pseudoscorpionidea). Zoologischer Anzeiger 100:53-67.
- Beier, M. 1954. Einige neue Pseudoscorpione aus dem Genueser Museum. Annali del Museo Civico di Storia Naturale di Genova 66:324-330.
- Beier, M. 1955. Pseudoscorpione von den Juan-Fernandez-Inseln (Arachnida Pseudoscorpionida). Revista Chilena de Entomología 4:205-220.
- Beier, M. 1959. Zur Kenntnis der Pseudoscorpioniden-Fauna des Andengebietes. Beiträge zur Neotropischen Fauna 1:185-228.
- Chamberlin, J.C. 1931a. The arachnid order Chelonethida. Stanford University Publications, Biological Sciences 7(1):1-284.
- Chamberlin, J.C. 1931b. A synoptic revision of the generic classification of the chelonethid family Cheliferidae Simon (Arachnida). Canadian Entomologist 63:289-294.
- Cooke, J.A.L. 1972. A new genus and species of oonopid spider from Colombia with a curious method of embolus protection. Bulletin of the British Arachnological Society 2:90-92.
- Dashdamirov, S.[D.] 1992. Identity of *Trichotowithius* Beier 1944 with a re-description of *Trichotowithius abyssinicus* Beier 1944 (Arachnida Pseudoscorpiones Withiidae). Tropical Zoology 5:293-298.
- Ellingsen, E. 1905. On some pseudoscorpions from

- South America in the collection of Prof. F. Silvestri. *Zoologischer Anzeiger* 29:323–328.
- Feio, J.L. de Araújo. 1944. *Victorwithius monoplocophorus* n. gen., n. sp. da subfamília Withiinae Chamberlin, 1931 (Pseudoscorpiones: Cheliferidae). *Boletim do Museu Nacional Riô de Janeiro*, n.s. *Zoologia* 28:1–7.
- Harvey, M.S. 1988. Pseudoscorpions from the Krakatau Islands and adjacent regions, Indonesia (Chelicerata: Pseudoscorpionida). *Memoirs of the Museum of Victoria* 49:309–353.
- Harvey, M.S. 1991. *Catalogue of the Pseudoscorpionida*. Manchester University Press, Manchester.
- Harvey, M.S. 1992. The phylogeny and systematics of the Pseudoscorpionida (Chelicerata: Arachnida). *Invertebrate Taxonomy* 6:1373–1435.
- Heurtault, J. 1971. Chambre génitale, armature génitale et caractères sexuels secondaires chez quelques espèces de Pseudoscorpions (Arachnida) du genre *Withius*. *Bulletin du Muséum National d'Histoire Naturelle, Paris* (2) 42:1037–1053.
- Heurtault, J. 1993. Un cas indirect de phorésie: les pseudoscorpions Withiidae des termitières mortes de *Macrotermes* en Afrique tropicale. *Bollettino dell'Accademia Gioenia di Scienze Naturali* 26:189–208.
- Hoff, C.C. 1956. Pseudoscorpions of the family Cheliferidae from New Mexico. *American Museum Novitates* 1804:1–36.
- Judson, M.L.I. 1997. Catalogue of the pseudoscorpion types (Arachnida: Chelonethi) in the Natural History Museum, London. *Occasional Papers on Systematic Entomology* 11:1–54.
- Mahnert, V. 1979. Pseudoskorpione (Arachnida) aus dem Amazonas-Gebiet (Brasilien). *Revue Suisse de Zoologie* 86:719–810.
- Mahnert, V. 1988. Die Pseudoskorpione (Arachnida) Kenyas. Familien Withiidae und Cheliferidae. *Tropical Zoology* 1:39–89.
- Muchmore, W.B. 1990a. Pseudoscorpionida. Pp. 503–527. *In* Soil biology guide. (D.L. Dindal ed.). John Wiley and Sons, New York.
- Muchmore, W.B. 1990b. *Termitewithius kistneri*, a new genus and species of termitophilous pseudoscorpion from Tanzania (Pseudoscorpionida: Withiidae). *Bulletin of the British Arachnological Society* 8:125–127.
- Muchmore, W.B. 1993. Annotated list and bibliography of Pseudoscorpionida (Arachnida) reported from the Caribbean region. I. Trinidad, Venezuela and Colombia, and including Aruba, Bonaire, and Curaçao. *Tropical Zoology, Special Issue* 1:83–104.
- Roewer, C.F. 1937. Chelonethi oder Pseudoskorpione. *In* Klassen und Ordnungen des Tierreichs. (H.G. Bronns ed.). Vol. 5(IV)(6)(1). Akademische Verlagsgesellschaft M.B.H., Leipzig.
- Smithers, P., P.M. Ramsay, A.N. Bond & M.E. Burne. 2001. Macroarthropod communities of the giant rosette plant, *Espeletia pycnophylla* subsp. *angelensis* Pp. 169–175. *In* The ecology of Volcán Chiles. (P.M. Ramsay ed.). Pebble and Shell, Plymouth.
- Vachon, M. 1952. La réserve naturelle intégrale du Mt. Nimba. II. Pseudoscorpions. *Mémoires de l'Institut Français d'Afrique Noire* 19:17–43.
- With, C.J. 1908. An account of the South-American Cheliferinae in the collections of the British and Copenhagen Museums. *Transactions of the Zoological Society of London* 18:217–340.

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